社会開発協力部報告書

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GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY, MALAYSIA
PERLIS-KEDAH-PULAU PINANG
REGIONAL WATER RESOURCES STUDY
PART 2
BERIS DAM FEASIBILITY STUDY

VOL. 2
ANNEX

A. SOCIO-ECONOMY
B. DOMESTIC AND INDUSTRIAL WATER SUPPLY

MARCH 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

NATIONAL WATER RESOURCES STUDY, MALAYSIA

PERLIS - KEDAH - PULAU PINANG

REGIONAL WATER RESOURCES STUDY

PART 2

LIST OF VOLUMES

Vol. 1 - MAIN REPORT

Vol. 2 - ANNEX   A.   SOCIO-ECONOMY

                 B.   DOMESTIC AND INDUSTRIAL WATER SUPPLY

Vol. 3 - ANNEX   C.   AGRICULTURE

                 D.   IRRIGATION DEVELOPMENT

Vol. 4 - ANNEX   E.   METEOROLOGY AND HYDROLOGY

                 F.   STUDY ON OPERATION OF WATER RESOURCES SYSTEM

Vol. 5 - ANNEX   G.   ENGINEERING GEOLOGY

                 H.   CONSTRUCTION MATERIAL

Vol. 6 - ANNEX   I.   DESIGN AND COST ESTIMATE

Vol. 7 - ANNEX   J.   ECONOMIC ANALYSIS

                 K.   LAND ACQUISITION COST AND ENVIRONMENTAL STUDIES

                 L.   LEGAL AND INSTITUTIONAL ARRANGEMENT

ABBREVIATIONS

(1) <u>Organization/Plan</u>

4MP (5MP)	:	Fourth (Fifth) Malaysia Plan
DID (JPT)	:	Drainage and Irrigation Department
EPU	:	Economic Planning Unit
FELCRA	:	Federal Land Consolidation and Rehabilitation Authority
FELDA	:	Federal Land Development Authority
IBRD	:	The World Bank
JICA	:	Japan International Cooperation Agency
MADA	:	Muda Agricultural Development Authority
MOH	:	Ministry of Health
MTR	:	Mid-Term Review of 4MP
NEB (LLN)	:	National Electricity Board
NWRS	:	National Water Resources Study
PWA	:	Pulau Pinang Water Authority
PWD (JKR)	:	Public Works Department
RESP	:	Rural Environmental Sanitation Program
RISDA	:	Rubber Industry Smallholders Development Authority
WHO	:	World Health Organization

(2) <u>Others</u>

B	:	Benefit
BOD	:	Biochemical Oxygen Demand
C	:	Cost
COD	:	Chemical Oxygen Demand
D & I	:	Domestic and Industrial
dia.	:	Diameter
EIRR	:	Economic Internal Rate of Return
El.	:	Elevation Above Mean Sea Level
Eq.	:	Equation
Fig.	:	Figure
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
H	:	Height, or Water Head
HWL	:	Normal High Water Level
O & M	:	Operation and Maintenance
Q	:	Discharge
Ref.	:	Reference
SS	:	Suspended Solid
VA	:	Value Added

ABBREVIATIONS OF MEASUREMENT

Length

mm = millimeter
cm = centimeter
m = meter
km = kilometer
ft = foot
yd = yard

Area

cm^2 = square centimeter
m^2 = square meter
ha = hectare
km^2 = square kilometer

Volume

cm^3 = cubic centimeter
l = lit = liter
kl = kiloliter
m^3 = cubic meter
gal.= gallon

Weight

mg = milligram
g = gram
kg = kilogram
ton = metric ton
lb = pound

Time

s = second
min = minute
h = hour
d = day
y = year

Electrical Measures

V = Volt
A = Ampere
Hz = Hertz (cycle)
W = Watt
kW = Kilowatt
MW = Megawatt
GW = Gigawatt

Other Measures

% = percent
HP = horsepower
° = degree
' = minute
" = second
°C = degree in centigrade
10^3 = thousand
10^6 = million
10^9 = billion (milliard)

Derived Measures

m^3/s = cubic meter per second
cusec= cubic feet per second
mgd = million gallon per day
kWh = kilowatt hour
MWh = Megawatt hour
GWh = Gigawatt hour
kWh/y= kilowatt hour per year
kVA = kilovolt ampere
BTU = British thermal unit
psi = pound per square inch

Money

M$ = Malaysian ringgit
US$ = US dollar
¥ = Japanese Yen

CONVERSION FACTORS

	From Metric System	To Metric System
Length	1 cm = 0.394 inch 1 m = 3.28 ft = 1.094 yd 1 km = 0.621 mile	1 inch = 2.54 cm 1 ft = 30.48 cm 1 yd = 91.44 cm 1 mile = 1.609 km
Area	1 cm^2 = 0.155 sq.in 1 m^2 = 10.76 sq.ft 1 ha = 2.471 acres 1 km^2 = 0.386 sq.mile	1 sq.ft = 0.0929 m^2 1 sq.yd = 0.835 m^2 1 acre = 0.4047 ha 1 sq.mile = 2.59 km^2
Volume	1 cm^3 = 0.0610 cu.in 1 lit = 0.220 gal.(imp.) 1 kl = 6.29 barrels 1 m^3 = 35.3 cu.ft 10^6 m^3 = 811 acre-ft	1 cu.ft = 28.32 lit 1 cu.yd = 0.765 m^3 1 gal.(imp.) = 4.55 lit 1 gal.(US) = 3.79 lit 1 acre-ft = 1,233.5 m^3
Weight	1 g = 0.0353 ounce 1 kg = 2.20 lb 1 ton = 0.984 long ton = 1.102 short ton	1 ounce = 28.35 g 1 lb = 0.4536 kg 1 long ton = 1.016 ton 1 short ton = 0.907 ton
Energy	1 kWh = 3,413 BTU	1 BTU = 0.293 Wh
Temperature	°C = (°F - 32)·5/9	°F = 1.8°C + 32
Derived Measures	1 m^3/s = 35.3 cusec 1 kg/cm^2 = 14.2 psi 1 ton/ha = 891 lb/acre 10^6 m^3 = 810.7 acre-ft 1 m^3/s = 19.0 mgd	1 cusec = 0.0283 m^3/s 1 psi = 0.703 kg/cm^2 1 lb/acre = 1.12 kg/ha 1 acre-ft = 1,233.5 m^3 1 mgd = 0.0526 m^3/s
Local Measures	1 lit = 0.220 gantang 1 kg = 1.65 kati 1 ton = 16.5 pikul	1 gantang = 4.55 lit 1 kati = 0.606 kg 1 pikul = 60.6 kg

Exchange Rate

(at the end of 1983)

US$1 = M$2.312
¥100 = M$0.998

ANNEX A

SOCIO-ECONOMY

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

I.   INTRODUCTION

1.1 Purposes of Part 2 Study

Final Report of Perlis-Kedah-Pulau Pinang Regional Water Resources Study Part 1 was submitted by Japan International Cooperation Agency (JICA) on February 1984. In Part 1 Study, socio-economic study was carried out with the objectives shown in Section 1.2. (Ref. A 22)

The Fourth Malaysia Plan (4MP) and Preliminary Field Count Summary of 1980 Population and Housing Census were used as the basic data in Part 1 Study. (Refs. A 1 & A 8)

After completion of Part 1 Study, Population Census in 1980 and Mid-Term Review of 4MP (MTR) became available. (Refs. A 2 & A 9)

In these Census and MTR, not only projected figures of population and GDP/GRP and value added of manufacturing sector in 1985 were changed downward but also figures in 1980 were revised in certain degrees.

Therefore in this Part 2 Study, main purpose of socio-economic study is to revise the previous projections, using above-mentioned revised data.

1.2 Objectives of the Socio-economic Study

The socio-economic study has been carried out to give future perspective of the socio-economic conditions of the Region in 1983, 1990 and 2000, as the basic framework for other sectoral studies. This study should be understood in this context and should not be considered as a proposal for future socio-economic planning. To serve for this purpose, projections are made for the following socio-economic items:

(1) Population of the States in the Region by district by Urban/Rural,

(2) Gross domestic product (GDP) of Malaysia and per capita GDP,

(3) Gross regional product (GRP) of the States in the Region and per capita GRPs,

(4) Gross value added of manufacturing sector of the States in the Region, and

(5) Gross value of manufacturing output by commodity group by State in the Region.

1.3 Contents of This Report

As the main purpose of the socio-economic study of Part 2 Study is to revise the projections made in Part 1 Study, detailed explanation of methodologies and basic assumptions for the projection are not repeated here and only the revised points are explained in this report. Readers are advised to refer to Annex A of the Final Report of Part 1 Study for details of methodologies and assumptions.

As in Part 1 Study, projections are made mainly based on trend methods and ratio methods.

1.4 National Economic Development Plan and MTR

Malaysia's Five Years Economic Development Plans have been prepared in compliance with the policies and principles stated in the New Economic Policy (NEP), i.e., eradication of the poverty and restruction of the society. Outline Perspective Plan (OPP) was initiated in 1971 to achieve the target of NEP set for 1990 and 4MP (1981 - 85) was prepared along this line.

Reflecting the recent unfavorable economic environment, the original 4MP targets were, however, revised downward in MTR, and the following new policy was further recommended:

(1) Developing the export-oriented industry, especially heavy manufacturing sector.

(2) Minimizing the Governmental expenditure and developing private activities.

(3) 70 million population policy

(4) Look east policy

2. POPULATION PROJECTION

2.1 Projection Procedure

Projection procedure of future population in the Region by urban/rural is illustrated in Fig. 2.

2.2 Population in 1980 in the Region

In Part 1 Study, population of national and state levels in 1980 were obtained from 4MP. However, in 1980 Population Census, revised population was given in national and state levels and these estimations were adopted in MTR (Tables 2 & 3).

Table 4 shows the comparison of estimated population in Malaysia and the States of Perlis, Kedah and Pulau Pinang in 1980 between 4MP and MTR. Estimations were revised downward about 4% both in Malaysia and the States in MTR.

Population of Perlis-Kedah was $1,330 \times 10^3$ in 1980 with the average annual growth rate of 1.2% during the period from 1970 to 1980. Population density increased from 109 persons/km^2 in 1970 to 123 persons/km^2 in 1980.

Population of Pulau Pinang was 970×10^3 in 1980 with the average annual growth rate of 1.7% during the period from 1970 to 1980. Population density increased from 774 persons/km^2 in 1970 to 918 persons/km^2 in 1980.

As no estimation was made in city/town levels in the Census, the data from Preliminary Field Count Summary in 1980 was used with adjustment to the estimation of 1980 Population Census for each state.

2.3 Modification in Part 2 Study

2.3.1 Projected population in Malaysia

Estimated population in Malaysia in 1983 and 1985 was obtained from MTR and the projected figures in 1990 and 2000 were provided by EPU Regional Section in June 1984.

Population in Malaysia, which was $13,745 \times 10^3$ in 1980 was projected to be $17,409 \times 10^3$ in 1990 and $21,259 \times 10^3$ in 2000. The average growth rate for 1980 - 2000 period was estimated at 2.2% per annum.

The projected population in Malaysia is shown in Table 5.

2.3.2 Projection of population by state

The parabolic function of population in whole Malaysia was assumed for the projection of population by state as in Part 1 Study.

In Part 1 Study, the projection was made based on the data for the years of 1980, 1985 and 1990 given in 4MP and OPP. In MTR, however, the figures are revised for 1980 and 1985 and estimation is not made for 1990. In Part 2 Study, therefore, revised figures for 1980 and 1985 given in MTR and that for 1970 given in 4MP were used.

2.3.3 Projection of urban population

The urbanization ratio is herein defined as the ratio of urban population, i.e., sum of the population of cities/towns of which population is larger than 10,000, to the total population. Cities/towns defined in this study are shown in Table 1. For 1970 and 1980, urbanization ratio was estimated using the figures in 1970 Population Census adjusted by 4MP and Preliminary Field Count Summary in 1980 adjusted by 1980 Population Census in this study.

Urbanization ratios in 1983 through 2000 were estimated, assuming the linear function as in Part 1 Study, with the revised figures of per capita GDP.

For the two new towns in Pulau Pinang, Bandar Seberang Jaya and Bandar Bayan Baru, the same assumption as in Part 1 Study was applied.

2.3.4 Projection of rural population

In Part 1 Study, each district rural population was projected as the function of state rural population.

In Part 2 Study, rural population in some districts were calculated to be negative or extremely large in 2000 in the states for which state rural population in 2000 were assumed to be less than those in 1980, if the same function as in Part 1 Study was applied. Therefore in Part 2 Study, each district rural population was projected first as parabolic function of total state population and then adjusted by state rural population.

2.4 Projected Population

2.4.1 Projected population in the States of Perlis, Kedah and Pulau Pinang

In the State of Perlis, the population will grow at the average growth rate of 1.4% per annum for 1980 - 2000 period, reaching 194 x 10^3 in 2000. In the State of Kedah, it will grow at the rate of 1.2% per annum, reaching 1,412 x 10^3 in 2000. In the State of Pulau Pinang, the growth rate will be 2.1% per annum with the population of 1,433 x 10^3 in 2000. The total population of these three states will grow at the average rate of 1.5% per annum, reaching 3,039 x 10^3 in 2000.

In 2000, about 14% of the population will live in urban area in the State of Perlis. It will be 23% in the case of the State of Kedah and 67%

in the case of the State of Pulau Pinang. Urban population of these three
states will account for about 43% of the total population in 2000.

The projected population by city/town and rural area in the States of
Perlis, Kedah and Pulau Pinang is shown in Tables 6 to 8.

2.4.2 Comparison with the projection of Part 1 Study

Estimated population in Malaysia in 2000 obtained from EPU for Part 2
Study was 21,259 x 10^3 which was 798 x 10^3 or 4% less than 22,057 x 10^3
obtained from EPU for Part 1 Study. Population in the State of Perlis in
2000 projected in this study is 23 x 10^3 or 11% less than that in Part 1
Study and 47 x 10^3 or 3% less in the case of the State of Pulau Pinang.
However, projected population in Kedah State in 2000 in this study is
14 x 10^3 or 1% more than that of Part 1 Study (Table 19).

In Part 1 Study, it was projected that about 13%, 22% and 68% of the
state population will live in urban area in 2000 in Perlis, Kedah and
Pulau Pinang State, respectively. In Part 2 Study the figures were revised
to 14%, 23% and 67% which show little difference compared with the figures
of Part 1 Study.

3. GDP AND GRP PROJECTION

3.1 Projection Procedure

Projection procedure of the future GDP of Malaysia and GRP of the states is illustrated in Fig. 3.

3.2 GDP of Malaysia and GRP of the States in 1980

In Part 2 Study, GDP of Malaysia and GRP of the States of Perlis, Kedah and Pulau Pinang in 1980 were obtained from MTR (Tables 9 & 10). As shown in Table 11, total GRP of the three States of Perlis, Kedah and Pulau Pinang is revised downward by about 3% due to the decrease of GRP of the State of Pulau Pinang by about 7%.

3.3 Assumption of GDP Growth Rates

In Part 1 Study, GDP of Malaysia and GRP of the States of Perlis, Kedah and Pulau Pinang were projected for 2 cases with different assumed growth rates of GDP up to 2000. In this Part 2 Study, the following one case was adopted, considering the actual achievements of the economies of Malaysia and the advanced countries after the completion of Part 1 Study as well as the revised projections for world economic environment made by the international institutions concerned.

GDP Annual Growth Rate

Unit: %

	1980/1985	1985/1990	1990/1995	1995/2000
Part 2	6.7	7.5	7.0	6.5
Part 1				
Case 1	7.6	8.4	7.5	7.5
Case 2	6.0	5.0	4.0	4.0

The assumed growth rate of 6.7% for 1980 - 85 period was adopted based on the figures given in MTR and growth rates thereafter were employed after a discussion with EPU Macro Section as to the rates to be used for this study in June 1984.

3.4 Modification in Part 2 Study

3.4.1 Projection of GRP of the States of Perlis, Kedah and Pulau Pinang

The same parabolic function as in Part 1 Study was applied for the projection of per capita GRP of the States of Perlis, Kedah and Pulau Pinang for this study.

In Part 1 Study the projection were made based on the data for the years of 1980, 1985 and 1990 given in 4MP and OPP. In MTR, however, the figures are revised for 1980 and 1985 and estimation is not made for 1990. In Part 2 Study, therefore, revised figures for 1980 and 1985 given in MTR and that for 1971 given in 4MP were used.

3.5 Projected GDP and GRP

3.5.1 GDP of Malaysia

GDP of Malaysia will grow at the average annual growth rate of 6.9% during 1980 - 2000 period, reaching M$97,256 x 10^6 in 2000 in terms of factor cost in 1970 constant price.

The projected GDP of Malaysia is shown in Table 12.

3.5.2 Per capita GDP and per capita GRP of the States of Perlis, Kedah and Pulau Pinang

Per capita GDP of Malaysia was obtained by dividing the GDP by total population in Malaysia. Per capita GDP will increase at the average annual rate of 4.6%, reaching M$4,575 in 2000 in terms of factor cost in 1970 constant price.

Per capita GRP of the states will increase as GDP increases and the increase rate will be higher for the states with lower GRP in 1980. Per capita GRP of the States of Perlis and Kedah will increase rapidly at the average annual growth rate of 5.8% which is higher than the national average of 4.6%, reaching M$3,526 in 2000. Per capita GRP of the State of Pulau Pinang will increase at the rate of 4.6%, reaching M$5,372 in 2000.

The projected per capita GDP and per capita GRP are shown in Table 13.

3.5.3 GRP of the States of Perlis, Kedah and Pulau Pinang

GRP of the States of Perlis and Kedah will grow at the average annual growth rate of 7.1% during 1980 - 2000 period, reaching M$5,663 x 10^6 in 2000 in terms of factor cost in 1970 constant price. That of the State of Pulau Pinang will grow at the rate of 6.8%, reaching M$7,698 x 10^6 in 2000. For the States of Perlis, Kedah and Pulau Pinang as a whole, it will grow at the rate of 6.9%, which is about the same as the average growth rate of GDP.

The Projected GRP is shown in Table 12.

3.5.4 Comparison with the projection of Part 1 Study

In the States of Perlis and Kedah, projected per capita GRP in 2000 in this study was 84% of that in Case 1 and 177% of that in Case 2 of

Part 1 Study (Table 21). Projected GRP in 2000 was 83% of that in Case 1 and 176% of that in Case 2 of Part 1 Study (Table 20).

In the State of Pulau Pinang, projected per capita GRP in 2000 in this study was 87% of that in Case 1 and 145% of that in Case 2 of Part 1 Study (Table 21). Projected GRP in 2000 was 84% of that in Case 1 and 140% of that in Case 2 of Part 1 Study (Table 20).

4. PROJECTION OF GROSS VALUE OF OUTPUT
IN MANUFACTURING SECTOR

4.1 Projection Procedure

Projection procedure of gross value of output in manufacturing sector in the Region is illustrated in Fig. 4.

4.2 Modification in Part 2 Study

4.2.1 Share of VA of manufacturing sector in Malaysia

In Part 1 Study, share of VA of manufacturing sector in GDP of Malaysia and that in GRP of each state in 1980, 1985 and 1990 obtained from 4MP were used for projecting the share up to 2000. However, mainly influenced by the stagnation of world economy, projected share of VA of manufacturing sector in GDP in 1985 is expected to decline to 18.5% from 19.1% in 1980 according to MTR.

Therefore, instead of using the trend method which was used in Part 1 Study, projection was made by following steps.

(1) Target share of manufacturing sector in GDP in 2000 was decided to 30%, considering the figures in the advanced countries and these in Malaysia in 1970s.

(2) Following equation was assumed and values of a and b were determined based on the X and Y values in 1985 obtained from MTR and 2000 projected in Chapter 3.4.1 and 4.2.1 (1).

$$Y = aX + b$$

where, Y: Share of VA of manufacturing sector in GDP of Malaysia

X: Per capita GDP of Malaysia

(3) The share of manufacturing sector in GRP of each state was projected using the same function and the same "a" value determined for Malaysia. Then, using the X and Y values in 1985, "b" value was determined for each state.

This methodology assumed that the share of manufacturing sector in GRP for each state will increase with the same elasticity as for Malaysia with regard to per capita figure.

4.2.2 VA of manufacturing sector in Malaysia by commodity group

Future VA of manufacturing sector in Malaysia by commodity group was projected using the same methodology as in Part 1 Study. However, for Peninsula Malaysia, revised information for commodity composition in 1980 and growth rates by commodity group for 1981 - 1985 were obtained from MTR and used in Part 2 Study (Tables 14 & 15).

4.3 Projected Gross Value of Output in Manufacturing Sector of the
     States of Perlis, Kedah and Pulau Pinang

     Share of manufacturing sector in GRP and gross value added of
manufacturing sector for the States of Perlis, Kedah and Pulau Pinang
projected according to the methodology given in the preceding section are
shown in Tables 16 & 17.

     Projected gross value of manufacturing output of the states was
obtained from the projected gross value added multiplied by value added
ratio by commodity group.

     Projected gross value of manufacturing output of the states in 1985,
1990 and 2000 are shown in Table 18.

4.4 Comparison with the Projection of Part 1 Study

     In the States of Perlis and Kedah, gross value of manufacturing
output was expected to reach M$3,890 x 10^6 in 2000, which is 66% of that
in Case 1 and 250% of that in Case 2 of Part 1 Study. In the State of
Pulau Pinang, gross value of manufacturing output is expected to reach
M$10,848 x 10^6 in 2000 which is 81% of that in Case 1 and 139% of that
in Case 2 of Part 1 Study (Table 22).

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      POPULATION TABLES PART I, PERLIS, DOS

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      1982, JICA

TABLES

Table 1   CITIES/TOWNS DEFINED IN THIS STUDY

State	District	City/Town
Perlis		
	Perlis	1. Kangar
Kedah		
	Pulau Langkawi	—
	Kubang Pasu	101. Jitra
	Padang Terap	—
	Kota Setor	2. Alor Setar
	Pendang	—
	Yan	102. Guan Chempedak
		103. Yan
	Sik	—
	Kuala Muda	3. Sg. Petani
		104. Tikan Batu
	Baling	203. Kuala Ketil
	Kulim	4. Kulim
	Bandar Bahru	—
Pulau Pinang		
	Seberang Perai Utala	5. Butterworth
		109. Kg. PMTG Kuching
	Seberang Perai Tengah	6. Bk. Mertajam
		110. Perai
		201. Bandar Seberang Jaya
	Selatan	—
	Timur Laut	8. Georgetown
		105. Air Itam
		106. Tg. Tokong
		107. Gelugor
		108. Tg. Bunga
	Barat Daya	202. Bandar Bayan Baru

Remark; Whole of the Pulau Langkawi district and major portion of
the Bandar Bahru district lies outside of the Region.

Table 2   POPULATION AND ITS GROWTH FROM 1970 TO 1980

Unit: 10^3

Region	$1970^{/1}$	$1980^{/2}$	Average Annual Growth Rate (%)
Peninsular Malaysia	9,147	11,427	2.3
Sabah	654	1,011	4.5
Sarawak	976	1,308	3.0
Whole Malaysia	10,777	13,746	2.5

Sources; /1:   Ref. A 1
          /2:   Ref. A 2

Table 3   POPULATION DISTRIBUTION BETWEEN URBAN AND RURAL
           BY ETHNIC GROUP IN PENINSULAR MALAYSIA

Unit: 10^3

Ethnic Group	$1970^{/1}$		$1980^{/2}$		Average Annual Growth Rate of Urban Population (%)
	Urban	Rural	Urban	Rural	
Malay	713	4,109	1,606	4,710	8.5
Chinese	1,557	1,717	2,166	1,699	3.4
Indian	338	640	485	686	3.7
Others	30	43	32	42	0.6
Total	2,638	6,509	4,289	7,137	5.0

Sources; /1:   Ref. A 1
          /2:   Ref. A 2

Table 4   COMPARISON OF ESTIMATED POPULATION
           IN 1980 BETWEEN 4MP and MTR

Unit: 10^3

State	4MP	MTR
Perlis	157	148
Kedah	1,173	1,116
P. Pinang	970	955
Sub-total	2,300	2,219
Others	11,961	11,526
Malaysia	14,261	13,745

Table 5   PROJECTED POPULATION IN MALAYSIA

Unit: 10^3

1980	1983	1985	1990	1995	2000
13,745[1]	14,811[1]	15,548[1]	17,409[2]	19,274[2]	21,259[2]

Sources; [1] : Ref. A 2

          [2] : EPU Internal Figures

Table 6   HISTORICAL AND PROJECTED POPULATION OF DISTRICTS
BY CITY/TOWN AND RURAL AREA IN PERLIS STATE

Unit: 10^3

District	City/Rural	Historical 1980	Estimated 1983	Estimated 1985	Projected 1990	Projected 2000
1. Perlis	1. Kangar	13	14	15	18	28
	Rural	135	142	147	155	166
Urban Total		13	14	15	18	28
Rural Total		135	142	147	155	166
State Total		148	156	162	173	194

Table 7   HISTORICAL AND PROJECTED POPULATION OF DISTRICTS
BY CITY/TOWN AND RURAL AREA IN KEDAH STATE

Unit: 10^3

District	City/Rural	Historical 1980	Estimated 1983	Estimated 1985	Projected 1990	Projected 2000
2. Pulau Langkawi	Rural	29	31	32	34	34
3. Kubang Pasu	101. Jitra	14	17	19	27	49
	Rural	121	120	119	118	117
District Total		135	137	138	145	166
4. Padang Terap	Rural	42	46	49	53	58
5. Kota Setar	2. Alor Setar	70	71	72	75	87
	Rural	219	234	244	261	277
District Total		289	305	316	336	364
6. Pendang	Rural	78	83	86	92	98
7. Yan	102. Guan Chempedak	8	9	9	11	14
	103. Yan	5	6	7	9	14
	Rural	48	47	47	55	66
District Total		61	62	63	75	94
8. Sik	Rural	45	46	47	49	50
9. Kuala Muda	3. Sg. Petani	45	48	50	57	79
	104. Tikan Batu	4	5	6	9	17
	Rural	151	160	166	174	194
District Total		200	213	222	240	290
10. Baling	203. Kuala Ketil	4	5	5	7	12
	Rural	104	103	102	98	93
District Total		108	108	107	105	105
11. Kulim	4. Kulim	26	29	31	38	56
	Rural	70	69	67	66	66
District Total		96	98	98	104	122
12. Bandar Bahru	Rural	33	32	32	31	31
Urban Total		155	165	172	208	328
Rural Total		961	996	1,018	1,056	1,084
State Total		1,116	1,161	1,190	1,264	1,412

Remark;   Whole of Pulau Langkawi district and major portion of
Bandar Bharu district lies outside of the Region.

Table 8 HISTORICAL AND PROJECTED POPULATION OF DISTRICTS
BY CITY/TOWN AND RURAL AREA IN PULAU PINANG STATE

Unit: 10^3

District	City/Rural	Historical 1980	Estimated 1983	Estimated 1985	Projected 1990	Projected 2000
13. Seberang Perai Utala	5. Butterworth	77	77	77	77	77
	109. Kg. PMTG Kuching	10	10	10	10	10
	Rural	124	124	124	124	124
District Total		211	211	211	211	211
14. Seberang Perai Tengah	6. Bk. Mertajam	29	29	29	29	29
	110. Perai	10	10	10	10	10
	201. Bandar Seberang Jaya	7	30	48	84	250
	Rural	126	126	126	126	126
District Total		172	195	213	249	415
15. Selatan	Rural	76	76	76	76	76
16. Timur Laut	8. Georgetown	253	253	253	253	253
	105. Air Itam	37	37	37	37	37
	106. Tg. Tokong	15	15	15	15	15
	107. Gelugor	14	14	14	14	14
	108. Tg. Bunga	11	11	11	11	11
	Rural	85	85	85	85	85
District Total		415	415	415	415	415
17. Barat Daya	202. Bandar Bayan Baru	15	40	53	89	250
	Rural	66	66	66	66	66
District Total		81	106	119	155	316
Urban Total		471	526	557	629	956
Rural Total		484	477	477	477	477
State Total		955	1,003	1,034	1,106	1,433

Table 9   GDP, GRP, PER CAPITA GDP AND
PER CAPITA GRP IN 1980

Region	GDP or GRP		Per Capita GDP or Per Capita GRP	
	Amount/1 (M$10^6)	Growth/2 Rate (%)	Amount/1 (M$10^6)	Growth/2 Rate (%)
Malaysia	25,410	8.1	1,849	5.6
Perlis	193	-	1,298	-
Kedah	1,248	-	1,119	-
Perlis - Kedah	1,441	6.7	1,140	5.4
P. Pinang	2,073	10.8	2,172	8.9

Remarks;   /1:   In 1970 constant price at factor cost.
           /2:   During 1971 - 1980 period.

Source;   Refs. A 1 & A 2

Table 10   GDP AND GRP BY SECTOR IN 1980

Unit: M$10^6

Sector	Perlis	Kedah	Pulau Pinang	Malaysia
Agriculture, forestry and fishing	88 (45.6)	643 (51.6)	731 (6.3)	6,255 (24.6)
Mining and quarrying	1 (0.5)	14 (1.1)	9 (0.4)	1,171 (4.6)
Manufacturing	23 (11.9)	69 (5.5)	710 (34.2)	4,875 (19.2)
Construction	5 (2.6)	30 (2.4)	75 (3.6)	1,209 (4.8)
Services	76 (39.4)	492 (39.4)	1,148 (55.5)	11,900 (46.8)
Total	193 (100.0)	1,248 (100.0)	2,073 (100.0)	25,410 (100.0)

Remarks;   (1):   In 1970 constant price at factor cost.
           (2):   Figures in parentheses signify the percentage
                  share of each sector in the GDP or GRP.

Source;   Ref. A 2

Table 11   COMPARISON OF ESTIMATED GDP AND GRP
            IN 1980 BETWEEN 4MP AND MTR

Unit : M$10^6

State	4MP	MTR
Perlis	168	193
Kedah	1,245	1,248
P. Pinang	2,221	2,073
Sub-total	3,634	3,514
Others	21,742	21,896
Malaysia	25,376	25,410

Table 12   PROJECTED GDP AND GRP OF THE STATES OF
PERLIS, KEDAH AND P. PINANG

Unit: M$10^6

Region	Actual 1980	Estimated		Projected	
		1983	1985	1990	2000
Perlis	193	226	249	363	781
Kedah	1,248	1,439	1,556	2,269	4,882
P. Pinang	2,073	2,561	2,936	4,048	7,698
Other States	21,896	26,584	30,513	43,932	83,895
Malaysia	25,410	30,810	35,254	50,612	97,256

Remark; At factor cost in 1970 constant price.

Table 13   PROJECTED PER CAPITA GDP AND PER CAPITA GRP
OF THE STATES OF PERLIS, KEDAH AND P. PINANG

Unit: M$

Region	Actual 1980	Estimated		Projected	
		1983	1985	1990	2000
Perlis	1,298	1,446	1,542	2,074	4,026
Kedah	1,119	1,239	1,309	1,795	3,458
P. Pinang	2,172	2,553	2,840	3,660	5,372
Other States	1,900	2,128	2,396	2,955	4,605
Malaysia	1,849	2,080	2,267	2,907	4,575

Remarks; At factor cost in 1970 constant price.

Table 14   ESTIMATED SHARE OF 11 COMMODITY GROUPS
IN MANUFACTURING SECTOR IN PENINSULAR
MALAYSIA IN 1980 AND 1985

Unit: %

| Commodity Group | Share | | | Average Annual Growth Rate[2] |
	1974[1]	1980[3]	1985[4]	1981 - 1985
Food	23.5	26.9	27.3	6.4
Textile	5.3	9.5	7.4	1.0
Wood	10.9	10.2	7.8	0.6
Paper	1.0	1.1	1.4	10.6
Publishing	5.2	3.2	3.7	10.2
Chemicals	10.4	11.0	11.7	7.5
Rubber	12.8	8.5	6.9	1.8
Nonmetal	5.2	5.0	4.8	4.9
Basic Metal	3.5	2.9	3.2	8.2
Machinery	21.8	20.9	25.2	10.2
Others	0.3	0.8	0.6	0.5
Total	100.0	100.0	100.0	5.7

Remarks; [1]: Source: Ref. A 10

[2]: Source: Ref. A 2, adjusted by the classification
adopted in this Study

[3]: Estimated based on the shares in Industrial Survey
in 1974 and 1978.

[4]: Estimated based on 1980 share and the growth rate
of the shares for 1981 - 1985 given in Ref. A 2

Table 15   COMPARISON OF ESTIMATED SHARE OF 11 COMMODITY
             GROUPS IN MANUFACTURING SECTOR IN PENINSULAR
             MALAYSIA BETWEEN PART 1 AND PART 2 STUDY

Unit: %

| Commodity | 1980 | | 1985 | |
Group	Part 1[1]	Part 2[2]	Part 1[1]	Part 2[2]
Food	22.2	26.9	19.2	27.3
Textile	7.6	9.5	6.7	7.4
Wood	10.8	10.2	9.6	7.8
Paper	1.2	1.1	1.4	1.4
Publishing	6.4	3.2	7.4	3.7
Chemicals	9.9	11.0	10.5	11.7
Rubber	8.5	8.5	9.0	6.9
Nonmetal	5.8	5.0	5.9	4.8
Basic Metal	3.3	2.9	3.5	3.2
Machinery	23.9	20.9	26.2	25.2
Others	0.4	0.8	0.6	0.6
Total	100.0	100.0	100.0	100.0

Remarks; /1: Based on 4MP

          /2: Based on MTR

Table 16 PROJECTED SHARE OF MANUFACTURING SECTOR IN GRP
FOR THE STATES OF PERLIS, KEDAH AND P. PINANG

Unit: %

State	Actual	Estimated		Projected	
	1980	1983	1985	1990	2000
Perlis-Kedah[1]	6.4	6.4	7.3	9.7	18.8
P. Pinang	34.2	34.1	34.4	36.7	44.1

Remark; [1]: Due to the availability of relevant data,
the States of Perlis and Kedah are treated
as one area.

Table 17 PROJECTED GROSS VALUE ADDED OF MANUFACTURING SECTOR
FOR THE STATES OF PERLIS, KEDAH AND P. PINANG

Unit: M$10^6

State	Actual	Estimated		Projected	
	1980	1983	1985	1990	2000
Perlis-Kedah[1]	92	106	131	256	1,065
P. Pinang	710	872	1,011	1,485	3,392

Remark; [1]: Due to the availability of relevant data,
the States of Perlis and Kedah are treated
as one area.

Table 18 PROJECTED GROSS VALUE OF MANUFACTURING OUTPUT
FOR THE STATES OF PERLIS, KEDAH AND P. PINANG
BY COMMODITY GROUP

Unit: M$10^6

Commodity Group	Perlis-Kedah[/1]				P. Pinang			
	1980	1983	1990	2000	1980	1983	1990	2000
Food	166	198	521	2,330	460	557	788	1,208
Textile	0	0	0	0	438	450	473	682
Wood	49	51	103	320	33	33	24	22
Paper	0	0	0	0	23	35	43	43
Publishing	0	0	2	8	41	55	71	71
Chemicals	0	0	0	4	142	193	220	220
Rubber	96	114	253	959	93	93	89	86
Nonmetal	4	4	12	64	15	17	19	37
Basic Metal	0	0	0	3	205	255	478	1,059
Machinery	10	10	32	197	839	1,134	2,580	7,420
Others	3	3	3	5	0	0	0	0
Total	328	380	926	3,890	2,289	2,822	4,785	10,848

Remarks; (1): In 1970 constant price

/1 : Due to the availability of relevant data,
the States of Perlis and Kedah are treated
as one area.

Table 19 COMPARISON OF THE PROJECTED POPULATION
BETWEEN PART 1 AND PART 2 STUDY IN 2000

Unit: 10^3

	Malaysia	Perlis	Kedah	Pulau Pinang
(1) Part 1	22,057	217	1,398	1,480
(2) Part 2	21,259	194	1,412	1,433
(2) - (1)	-798	-23	14	-47

Table 20 COMPARISON OF THE PROJECTED GDP OF
MALAYSIA AND GRP OF THE STATES BETWEEN
PART 1 AND PART 2 STUDY IN 2000

Unit: M$$10^6$

	GDP of Malaysia	GRP of Perlis-Kedah	GRP of Pulau Pinang
Part 2	97,257	5,659	7,697
Part 1			
Case 1	113,068	6,804	9,111
Case 2	64,155	3,209	5,485

Table 21   COMPARISON OF THE PROJECTED PER CAPITA GDP
            AND PER CAPITA GRP OF THE STATES BETWEEN
            PART 1 AND PART 2 STUDY IN 2000

Unit: M$

	Per Capita GDP of Malaysia	Per Capita GRP of Perlis-Kedah	Per Capita GRP of Pulau Pinang
Part 2	4,575	3,526	5,372
Part 1			
Case 1	5,126	4,213	6,156
Case 2	2,909	1,987	3,706

Table 22   COMPARISON OF MANUFACTURING SECTOR BETWEEN
            PART 1 AND PART 2 STUDY IN 2000

	Projected Share of Manufacturing Sector in GRP (%)	Projected VA of Manufacturing Sector (M$10^6)	Projected Gross Value of Manu-facturing Output (M$10^6)
Perlis-Kedah			
Part 2	18.8	1,065	3,890
Part 1			
Case 1	23.6	1,606	5,897
Case 2	12.8	411	1,556
Pulau Pinang			
Part 2	44.0	3,392	10,848
Part 1			
Case 1	48.5	4,419	13,337
Case 2	47.1	2,583	7,778

FIGURES

Fig. 1 Administrative Division in the Study Area
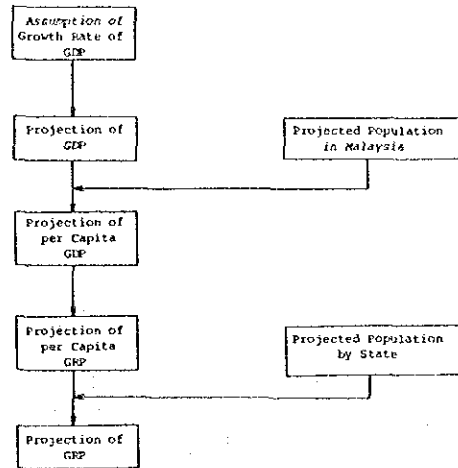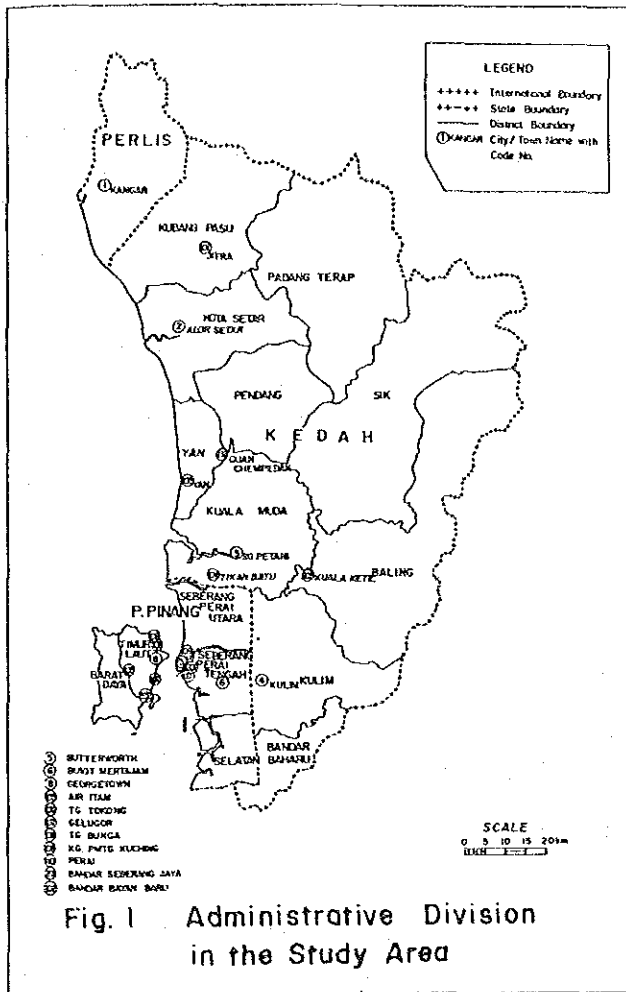
Fig. 3 Projection Procedure of GDP and GRP
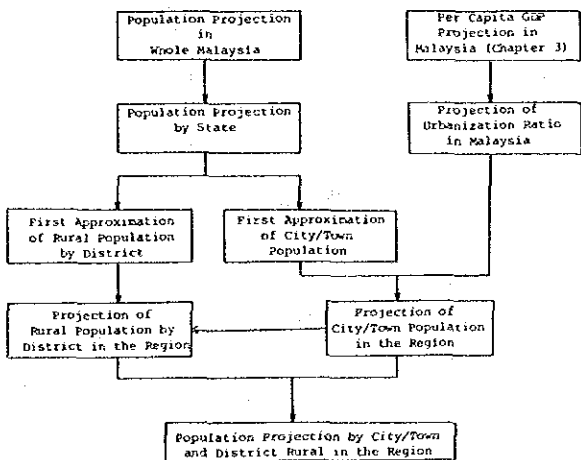
Fig. 2 Projection Procedure of Population
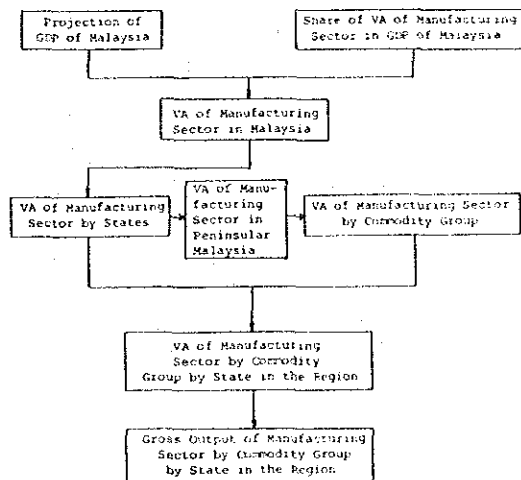
Fig. 4 Projection Procedure of Gross Value of Output in Manufacturing Sector

ANNEX B
DOMESTIC AND INDUSTRIAL WATER SUPPLY

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

SPECIAL ABBREVIATIONS

D & I Water Demand : Domestic and Industrial Water Demand

D & M Water Demand : Domestic and Manufacturing Water Demand

C.D. : Customer Demand

S.D. : Source Demand

UA Ratio : Unaccounted for Water Ratio

TP Ratio : Treatment Plant Water Use Ratio

PCDU : Per Capita Daily Use

lpcd : liter per capita per day

RESP : Rural Environmental Sanitation Program

FFB : Fresh Fruit Bunch

DRC : Dry Rubber Content

SLDB : Sabah Land Development Board

1. INTRODUCTION

This Annex was prepared to present the results of the domestic and industrial water demand (D&I water demand) study for the Region, i.e., the States of Perlis, Kedah and Pulau Pinang excluding Pulau Langkawi district and the major portion of Bandar Baru district in the Kedah State in 1990 and 2000 as well as to explain the methodologies adopted. Estimation was also made for 1983 to give the idea of the distribution of the water consumption and supply in the Region. Both water demand for public supply, i.e., PWD, PWA and Rural Environmental Sanitation Program (RESP) and private water demand, which were to be supplied either through surface or groundwater resources, were estimated. In addition, outline calculation was made for public fund needs to roughly indicate the order of requirement expected in the public sector up to 2000. Overall economic cost required for the construction and operation and maintenance of the public and private water supply facilities was estimated to show the total cost of water supply from the national viewpoint.

Socio-economic indices required for water demand projection were taken from the outputs of Annex A "Socio-Economy". Methodologies and assumptions adopted for this Study are about identical with these for Part 1 Study, though some revisions were made based on the data and information obtained during this Study. Major references and data sources are listed in the last page of the text of this Annex.

2. PRESENT CONDITION OF D & I WATER SUPPLY AND USE IN THE REGION

2.1 PWD and PWA Water Supply and Use

In the State of Perlis, PWD supplied 3.0×10^6 m^3/y of water in 1978 in terms of treatment plant output (Table 1). In 1981, Kedah State PWD supplied 45.6×10^6 m^3/y (Table 1). PWA of the State of Pulau Pinang supplied 86.3×10^6 m^3/y in 1982 (Table 2). According to the available data, no major increase was recorded for PWD supply in the State of Perlis from 1975 through 1978. In the State of Kedah, PWD supply rapidly increased at the average annual growth rate of 12.5%. PWA supply in the State of Pulau Pinang recorded moderate increase of supply with 5.0% annual growth.

Abstraction and treatment capacity of PWDs of the States of Perlis and Kedah, and PWA in 1982 are given in Tables 3 to 5 together with proposed capacity in 1985. Water supply regions for PWD and PWA water supply in the States of Perlis, Kedah and Pulau Pinang in 1984 are shown in Fig. 1.

In 1982, recorded capacity of Perlis PWD water supply was 8.0×10^6 m^3/y. About half of the capacity is for the Arau canal facilities and the rest is for groundwater exploitation. In the State of Kedah, PWD controlled the supply facilities with 76.6×10^6 m^3/y of capacity, out of which about 14.9×10^6 m^3/y of capacity was for temporary facilities that were to be abolished within the following five years. Major water source was the rivers of Kedah and Muda. Groundwater use was negligible. PWA operated the supply facilities with 112.4×10^6 m^3/y of capacity. Major water source were the rivers of Muda and Kulim in Seberang Perai and the Pulau Pinang river in Pulau Pinang. No groundwater was exploited for PWA supply.

2.2 Rural Environmental Sanitation Program

In 1980, about 166×10^3 people were supplied with untreated water through RESP in the isolated rural areas of the States of Perlis, Kedah and Pulau Pinang. Majority of the beneficiaries lived in the State of Kedah, accounted for 93% of the total. According to the plan prepared by MOH for 4MP, about 285×10^3 rural inhabitants were scheduled to be provided water under the Program at the end of 1983.

2.3 Processing Water Use in Palm Oil Mills and Rubber Factories and Tin Mine Water Use

Palm oil processing water use was quite limited in the Region in 1983, consuming only 38×10^3 m^3/y in total. In 1983, 39 rubber factories were located in the Region. The total water use in the Region amounted to about 5.8×10^6 m^3/y. Water use of palm oil mills and rubber factories was recorded only for the States of Kedah and Pulau Pinang. No water use was recorded in the Perlis State.

Though no statistical data were available about the actual water use of tin mines, none of the 35 tin mines located in the States of Perlis and Kedah possessed water licenses issued by the Mines Department in 1980, indicating their river water use was negligible.

2.4 Water Tariff, Revenues and Expenditures

Water tariff for the States of Perlis, Kedah and Pulau Pinang in 1984 remain the same as that in 1983. Average water charge was M$0.23/m^3 in 1978 for the State of Perlis. They were M$0.31/m^3 for the State of Kedah and M$0.23/m^3 for the State of Pulau Pinang in 1981. Though the total revenue exceeded the recurrent expenditure for the States of Kedah and Pulau Pinang, the recurrent expenditure far exceeded the revenue in the State of Perlis.

3. PROJECTION OF D & I WATER DEMAND

3.1 General

Methodologies and assumptions for D & I water demand projection is almost identical with these in Part 1 Study except the assumptions made for groundwater use and the ratio of manufacturing water demand to be met by public supply. Groundwater use was assumed to be nil in the State of Kedah besides the State of Pulau Pinang based on the recent information about groundwater potential in the State of Kedah (Ref. 33). Likewise the ratio of public water supply for manufacturing use was revised to 90% in the States of Kedah and Perlis from 50% in Part 1 Study.

Socio-economic indices required for D & I water projection including population and gross value of manufacturing outputs were revised according to the outputs of Annex A "Socio-Economy" of Part 2 Study.

Tin mine water use is negligible in the Region and no projection was made for it in this study.

In the following sections of this Chapter, methodologies and assumptions for D & I water demand projection are briefly explained and projected demand figures are presented.

3.2 Projection of Domestic Water Demand

3.2.1 Methodologies

Domestic water demand for public and private supply was projected for cities/towns and the rural areas in the Region for 1990 and 2000, and estimation was made for 1983. Customer Demand (C.D.) for treated water was obtained for each area as follows:

Treated Water Demand = Population x Service Factor x PCDU
(Per Capita Daily Use)

Accordingly C.D. for private water was estimated for each area as follows:

Private Water Demand = Population x (1-Service Factor) x PCDU

Source demand (S.D.) was calculated by dividing C.D. by the product of unaccounted for water ratio (UA ratio) and treatment plant water use ratio (TP ratio).

Estimated and projected service factor and per capita daily use in 1983, 1990 and 2000 are given in Tables 6 to 8.

3.2.2 Projected served population

In 1983, it was estimated that about 83% of the population was served by public water supply either by PWD or under RESP in the State of Perlis. The overall coverage of public water supply was estimated at 68% for the State of Kedah and 88% for the State of Pulau Pinang. The total served population in the Region was estimated at $1,763 \times 10^3$ people (Tables 9 & 10).

Based on the projected population and service factor, population to be served by public supply systems including RESP (MOH) was estimated. During 1983 - 2000 period, served population in the Region will grow at the average growth rate of 3.1% per annum and the entire population of 3.0×10^6 will be served by public systems in 2000. Among the three States of Perlis, Kedah and Pulau Pinang, Kedah State will record the highest growth rate of population served with 3.5% per annum on the average. Pulau Pinang State will mark 2.9% per annum and 2.4% per annum for the Perlis State.

3.2.3 Projected domestic water demand

In the Region, S.D. of the total domestic water demand will grow at the average growth rate of 5.3% per annum during 1983 - 2000 period, reaching 256×10^6 m^3/y in 2000, of which 55% will be generated in urban area and the rest in rural area. The total domestic water demand will account for 40% of the total demand in 2000.

Domestic water demand for public supply was projected to grow rapidly reflecting population increase, rapid improvement of service factor and the increase of per capita daily use. Total domestic water demand for public supply comprising PWD, PWA and RESP will grow at the average growth rate of 5.8% per annum during the same period. In 2000, domestic water demand will fully be met by public supply systems, namely the total domestic water demand of 256×10^6 m^3/y will be supplied by public systems.

Reflecting the rapid improvement of public water supply, the private water demand in the Region will sharply decline from the estimated 7.3×10^6 m^3/y or about 6.9% of the total domestic water demand in 1983 to nil in 2000 when 100% coverage target will be attained.

Projected domestic water demand by type of supply is given in Tables 11 to 16.

3.3 Projection of Manufacturing Water Demand

3.3.1 Methodologies

Manufacturing water demand was projected for cities/towns and rural area in the Region for 1990 and 2000 and estimation was made for 1983. C.D. for treated water was obtained by gross value of manufacturing output by commodity group projected in Annex A and net unit water use by commodity group (Table 17). Distribution of the gross value among the cities/towns

and rural area was estimated based on the actual ratio in 1974 and the prospective economic structure of cities/towns and rural area, assuming the value of the rural area would remain constant after 1983 (Table 18). S.D. was calculated based on C.D. considering UA ratio and TP ratio.

3.3.2 Projected manufacturing water demand

Manufacturing water demand was projected to rise sharply due to the rapid growth of manufacturing industries.

S.D. of total manufacturing water demand will grow at the average growth rate of 7.1% per annum during 1983 - 2000 period, reaching 304 x 10^6 m^3/y in 2000, of which 94% will be generated in urban area and the rest in rural area. The total manufacturing water demand will account for 54% of the total demand.

Total manufacturing water demand for public supply by PWD and PWA will grow at the average growth rate of 7.2% per annum during the same period, reaching 274 x 10^6 m^3/y in 2000, of which 94% will be generated in urban area and the rest in rural area. Total manufacturing water demand for public supply will account for 90% of the total manufacturing water demand, the rest, 10%, being met by private facilities in 2000.

Projected manufacturing water demand by type of supply is given in Tables 11 to 16.

3.4 Projection of Processing Water Demand in Palm Oil Mills and Rubber Factories

3.4.1 Methodologies

The processing water demand of palm oil mills and rubber factories was projected based on the processing schedule of palm oil and rubber which was projected in Annex C "Agriculture" by multiplying the estimated unit water use per unit production of palm oil and rubber. The processing water demand per unit production of palm oil was estimated at 0.8 m^3 per one ton of fresh fruit bunch (FFB) of oil palm based on the data provided by DOE and SLDB. The processing water demand per unit production of rubber was estimated at 18 m^3 per one ton of dry rubber concentrate (DRC) based on the data provided by DOE and SLDB.

3.4.2 Projected palm oil and rubber processing water demand

Palm oil processing in the Region is not significant. The total water demand in the Region in 2000 will be only 220 x 10^3 m^3/y. The water demand for rubber processing in the Region will be about doubled by 2000, reaching 11 x 10^6 m^3/y. The projected palm oil and rubber processing water demand are given in Table 19.

3.5 Projected D&I Water Demand

Total domestic and manufacturing water demand (D&M water demand) was projected to rise sharply due to the combined effect of i) population increase, ii) service factor improvement, iii) per capita consumption increase and iv) growth of manufacturing industries.

S.D. of total domestic and manufacturing water demand will grow at the average growth rate of 6.2% per annum during 1983 - 2000 period, reaching 560×10^6 m^3/y in 2000, of which 79% will be generated in urban area and the rest in rural area. Total D&M water demand is given in Tables 11 to 16.

Compared with the projected figures in Part 1 Study, domestic water demand in 2000 in Part 2 Study is about the same as that in Case 1 of Part 1. The small difference is attributable to the difference of the served population and its distribution in urban and rural areas. Manufacturing water demand in 2000 in Part 2 Study is 67% of that in Case 1 of Part 1 Study and 134% of that in Case 2 of Part 1 Study, reflecting the differences in gross value of manufacturing outputs. Reflecting the increased coverage ratio of public supply, public supply for manufacturing water demand in Part 2 Study exceeds that in Case 1 of Part 1 Study by small margin. Total D&M water demand in Part 2 Study is 79% of that in Case 1 of Part 1 Study and 132% of that in Case 2 of Part 1 Study. Total public supply for D&M water demand in Part 2 Study is about the same as that in Case 1 of Part 1 Study. Comparison of projected water demand between Part 1 Study and Part 2 Study is shown in Table 20.

Projected processing water demand in palm oil mills and rubber factories in Part 2 Study is identical with that in Part 1 Study.

3.6 Projected D&I Water Abstraction at River Intakes

In order to serve for the water balance study and water pollution abatement study as well as cost allocation of source facilities, water abstraction volume for domestic and industrial use at each river intake was projected by purpose and by type of supply by water supply region in 1990 and 2000. Estimation was made for 1983. Projected D&I water abstraction at the intakes by purpose is given in Table 21 and that by type of supply is given in Table 22.

4. CONSTRUCTION AND O & M COSTS FOR PUBLIC AND PRIVATE WATER SUPPLY

Construction cost and O & M cost for public and private water supply facilities required to meet the projected water demand were estimated in the same manner as in Part 1 Study. Relevant prices and costs remained stable in 1983 and the same unit costs as these used in Part 1 Study were applied in Part 2 Study. Estimated construction and O & M costs for public and private water supply facilities are given in Tables 23 to 26.

5. ECONOMIC COST AND BENEFIT FOR D & I WATER SUPPLY

5.1 Economic Cost

Economic cost was estimated in the same manner as in Part 1 Study as given hereunder.

Economic construction cost (investment cost) for PWD and PWA water supply was estimated by deducting the transfer payment from the financial cost. The transfer payment including taxes and local contractors' profit was assumed at 20% of the financial cost.

Unit economic construction cost for rural public water supply through RESP (MOH) was estimated at M$1,890 per m^3/d of supply capacity, taking into account the economic value of the labor provided by the rural inhabitants for the construction. Unit economic construction cost for water supply for palm oil mills and rubber factories was estimated at M$750 per m^3/d of supply capacity by deducting transfer payment from the financial construction cost based on the data obtained from SLDB. That for private water supply for domestic use was assumed at M$110 per m^3/d based on the expenditure on tools and economic cost of labor of the rural inhabitants to fetch water from nearby water sources.

Economic O & M cost was assumed at 2% of the economic construction cost.

The estimated economic construction and O & M costs are given in Tables 27 and 28, respectively.

5.2 Economic Benefit

Economic benefit to be derived from water supply including both public and private ones for domestic and industrial uses was estimated by the equivalent economic cost of the least-costly alternative facilities as in Part 1 Study.

For the water source facilities including dams and diversion facilities, various alternatives were planned and the least-costly alternative was selected. In case the source facilities serve for multiple purposes, appropriate cost attributable to D & I water supply was considered as alternative cost. For the cost of direct facilities comprising intakes, water mains, treatment and distribution facilities, no alternatives were considered, i.e., least-costly alternative cost is identical with that of the proposed facilities. The economic costs of the water source facilities are given in ANNEX J "Economic Analysis".

6. REVISED ESTIMATE OF INDUSTRIAL WATER DEMAND

After submission of the Draft Final Report in January 1985, the Joint Steering Committee meeting was held on January 28, 1985. In the meeting, PWA gave a comment on industrial water demand of the State of Pulau Pinang. PWA felt that if the increasing water demand due to the water-intensive industries, mainly the chemical and paper industries would cause the incremental water deficit, it may be possible to convince the State authorities to reduce the number of such industries in order to curtail industrial water demand.

Accordingly the Study Team made a review of the industrial water demand and revised the water demand assuming that; the gross value of manufacturing output of paper, publishing and chemical industries in the State of Pulau Pinang is remained constant at 1985 level after 1985.

The resulting total industrial water demand in the State of Pulau Pinang is estimated at 107×10^6 m^3/y for 1990 and 188×10^6 m^3/y for 2000. (The estimates in the previous section were 123×10^6 m^3/y for 1990 and 270×10^6 m^3/y for 2000.)

Table 29 shows the comparison of total domestic and industrial water demand between the estimates given in the previous section and the revised ones.

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TABLES

Table 1   PWD WATER SUPPLY RECORD FOR 1978 AND 1981

State	Normal Operating Capacity $(10^3 \ m^3/d)$	Total Quantity of Water Supplied $(10^6 \ m^3/y)$	Total Quantity of Water Metered $(10^6 \ m^3/y)$	UA Ratio (%)
Perlis	6	3.0	1.0	67
Kedah	127	45.6	21.7	52

Remark;   In 1978 for Perlis and in 1981 for Kedah.

Source;   Refs. B 4 and B 5

Table 2   PWA WATER SUPPLY RECORD FOR 1980 - 1982

Unit: $10^6 \ m^3/y$

Area	1980	1981	1982
Pulau Pinang	44.1	48.4	48.3
Seberang Perai	34.2	38.0	38.0
Total	78.3	86.4	86.3

Remark;   In terms of metered consumption

Source;   Ref. B 6